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ABSTRACT

This document provides a description and evaluation of a project designed to develop leadership among K-8 mathematics teachers in San Francisco (California). The project attempted to: (1) provide teams of urban teachers with a year-long program to improve mathematical problem solving skills, build confidence, and increase classroom effectiveness; (2) provide participants with ongoing training; (3) provide support for these teachers as they developed workshops for their colleagues; and (4) enlarge the group of mathematics leaders in the San Francisco Bay Area. The report concludes that data from a variety of sources indicate that the 1987 project year was a highly successful one. (PK)

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MAKING MATH LEADERS: THE SAN FRANCISCO MATH LEADERSHIP PROJECT

Paper presented at the
National Council of States on Inservice Education
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San Diego Princess Hotel
San Diego, California

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FINAL EVALUATION REPORT, PROJECT YEAR 1986-87

prepared by

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MAKING MATH LEADERS: THE SAN FRANCISCO MATH LEADERSHIP PROJECT

I'm very glad to be here and have the opportunity to share information about the San Francisco Math Leadership Project. We are currently in the fourth year of this project, which is one of sixteen California Mathematics Projects funded by the State of California. Each project is connected with either the University of California (UC) system or the California State University (CSU) system. The overall structure of this project differs from the others in the following ways: it is one of the only two projects that work with teachers of K-8, rather than K-12, 9-12, or 7-12; and it is the only project concentrating on teachers from a single school district.

To put a math project into some perspective, I'd like to mention current events concerning mathematics education in California. Two major documents have recently been published by the California State Department of Education: The Mathematics Framework, in 1985, and the Mathematics Model Curriculum Guide, in 1987. In addition, the adoption of new mathematics textbooks, which was delayed for one year, has just ended. There was a delay because there was not a close enough match between the textbooks and the framework, thus forcing the publishers to make some changes. In case you're not familiar with the framework I have some highlights to share with you. These are my own highlights; after you read the document, I'm sure you'll choose others.

> "By brainstorming, exploring various approaches, and solving problems cooperatively, students can gain confidence in their individual abilities..."
>
> "Most learners, including those adults who usually function at the abstract level, profit from using concrete materials when they encounter a new concept or a difficult problem..."
>
> "Manipulative materials can be used profitably to introduce concepts, even at the high school level..."

"The processes of problem solving are neither a recipe nor magic b t rather a collection of strategies that students can use to solve problems..."

"Allow for the fact that more than one strategy may be needed to solve a given problem and that problems may require original approaches..."

"Before the end of the sixth grade, students should have calculators continually available for use — in class, on homework assignments, and on tests..."

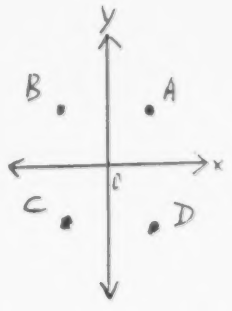
"Adequate time for problem solving must be provided because the students, not the teacher, must do the thinking, make decisions, and find successful means to solve the problems..."

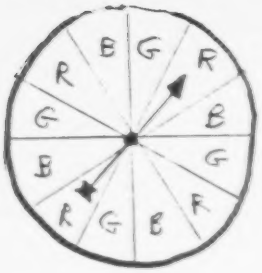
It is an enormous undertaking to try to reeducate elementary teachers, many of whom do not consider math their favorite subject. Some of them, perhaps, entered the teaching profession precisely because there were no college math requirements; many have not taken a math course since high school.

Here is some information about the ninety-eight teachers we've worked with during these past four years. We've aimed for a spread of grade levels: forty-two teach grades K-2; 34 teach grades 3-5; 8 teach grades 6-8; and 14 hold other positions such as resource teachers. The average number of years of teaching experience for '84 participants is 13.9; for '85 participants is 8.4, and for '86 participants, 11.5 years.

On the first day of the summer institute we give a pre-test. Over the years, of the following three test items about 33% have missed the first two, and 80% have missed the third.

Which point could have the coordinates $(3, \bar{3})$?





The sectors of the spinners are colored Red (R), Blue (B), and Green (G). What is the probability that the spinner will stop on Blue (B) if you spin it one time?

The following are the numbers of students in nine rooms in the Jackson Elementary School:

27 29 35 12 15 29 19 24 30

Compute the MEAN, MEDIAN, AND MODE.

Our task, as you can see, is twofold: to increase the mathematical knowledge of these teachers, and then build their confidence in their own ability to do mathematics and to teach it. We must also give them the opportunity to enjoy learning math so they can bring this excitement, creativity, and confidence to their students.

There are several different aspects of this project I'd like to share with you. But I will limit myself to two that are most appropriate for this particular conference. First, I'd like to describe the leadership development component, as it is this model that can possibly be transferred to other subject areas. Then, I'd like you to get a flavor of the strategies we use to build the teachers' confidence by trying a few exemplary math problems. First, let's look at the goals of the project:

1. To provide teams of urban classroom teachers with a year long program that will improve their own mathematical / problem solving skills, build their confidence, and increase their effectiveness as classroom teachers.

2. To provide the participants with ongoing training in two ways: through classroom visitation at their school sites; and through monthly problem solving / support sessions.

3. To facilitate an outreach to classroom teachers by preparing the participants to share their expertise with colleagues in their schools and district; by providing assistance in the development of workshops; and by funding basic materials for each participating school.

4. To enlarge the existing nucleus of mathematics leaders in the Bay Area by including these partcipants as active contributors to local conferences, to their district inservice programs, and primarily to their own schools.

We attempt to meet these goals with the following basic structure of the project. The intensive 4-week summer institute meets for 4 whole days, 4 days each week. The participants are surrounded by mathematics; they are paid stipends and receive credit and materials for their classrooms. During the years there are monthly meetings at the university, classroom visits, demonstration lessons and workshop support by project directors. The teachers are required to present two workshops at their school sites and to attend a math conference. There is also a reunion for past participants.

With additional funding from The San Francisco Foundation we have been able to purchase manipulative materials for each school, and also offer a 1-unit course during the year. For two years this course was on using computers, this year it will focus on algebra through the grades.

The leadership development begins immediately in the summer institute. Most of the fourth week is devoted to practice workshops given by current participants. During the third week a portion of each afternoon is devoted to having past participants help the new ones prepare for these workshops. Participants from the previous year are all invited to give presentations at this summer institute, and some past participants are invited back as special guests to speak on particular topics that they've developed during the past years.

We give preference to pairs of teachers from the same school. They then return to their schools and we have, in fact, provided the principals with 'math experts.' The workshops they give at their own sites have been very well received, and their leadership potential has been tapped. We've started telling the teachers that they're making a lifetime commitment when they join the project. Many past participants continue to attend our monthly meetings and the district does support us by paying participants, current and past, for giving workshops at their sites. They've also been able to give workshops to schools not in the project.

Leadership opportunities must be provided for our past participants. Many of them have received grants to inservice their staffs and to buy more materials for their schools. Some teachers joined together last year to write a grant to present math faires at their schools. The district has also provided opportunities for them. Several are on the Textbook Adoption Committee; others are on the Math Curriculum Development Committee. And finally, some of our teachers are beginning to speak at conferences. This year, several have been invited to speak at the Northern Section of the California Mathematics Council Annual Conference held at Asilomar. Our most recent attempt at providing leadership involves integrating with the district's mentor teacher program. We have recently begun to organize grade level ongoing planning groups, led by past participants who are also mentor teachers.

The most important thing we've learned is that leadership development takes time. In the final report is included some data collected in 1987 from the teachers as they self-evaluate their own classrooms. In general, the longer the teachers have been in the project, the higher they rate themselves.

Currently, ninety-eight teachers in San Francisco representing thirty-three public and seven private schools have been in this project. All will give the two required workshops at their own sites. Many have continued to grow in this area. It is necessary for the district to utilize the talents of these teachers. Leadership takes many forms. In this project, the classroom is the most important unit, followed by leadership in their school sites. Then, some, but not all, become interested in working with other schools and expanding their workshop repertoire.

The district is not the only beneficiary of this work. The Department of Elementary Education has also gained. To me, the most important benefit is having model classrooms in which to place our students, both for their math observation / participation, and for their student teaching. Many have returned to take courses, or to enter graduate programs, and several are involved in various other department projects. Several teachers were made adjunct professors and are currently team-teaching a seminar for student teachers. I repeat, leadership takes many forms, many of which we cannot project at the outset of an undertaking such as this. It is important, however, to recognize this leadership ability, to encourage it, and to reward it. I believe we have been successful in developing math leadership in the San Francisco Unified School District.

SAN FRANCISCO MATH LEADERSHIP PROJECT

Final Evaluation Report
1986-1987 Project Year

This report summarizes project evaluation data analyzed by an external evaluator in order to provide an independent assessment of the project's effectiveness based on project data. The evaluation plan for 1986-87 was comparable to that used in previous project years and incorporated both instruments developed by the California Mathematics Project and the local project staff. Most of the data summarized here reflects the experience of the 1986-87 participants. However, there are also some follow-up data available from prior project participants, specifically the 1984-85 and 1985-86 groups. The principal sources of evaluation data are: 1) Pre-Institute Questionnaire and End of First/Second Year Form (questions matched for pre-post comparability); 2) Knowledge of Mathematics Pre-Test/Post-Test, Parts I and II; 3) Daily Evaluations of Summer Institute; 4) Final Evaluation of Summer Institute; 5) Evaluation of Monthly Follow-up Meetings; 6) Feedback from Teaching Colleagues and Parents who Attended Workshops Provided by Participants; 7) Self-Evaluation of Own Classroom and Impact of Project on Own Teaching Practices; 8) Information on Math Related Activities Pursued During 1986-87 School Year; 9) Evaluation of Spring, 1987 Computer Course; and 10) Feedback from the Summer Reunion, 1987.

Data regarding the 1986 Summer Institute were provided in the interim evaluation report submitted in October of 1986. Therefore these data will be briefly summarized in this report. The reader is directed to the interim report for more detail and copies of appropriate evaluation instruments. While the focus of this report is on the experience of the 1986-87 participants, the data available from 1984-85 and 1985-86 participants will be integrated into the summary of findings.

1. Pre-Institute Questionnaire and End of First/Second Year Form. Prior to both the 1985 and 1986 Summer Institutes, participants were sent a detailed questionnaire requesting information on their math background, their teaching experience, and their knowledge and views on various aspects of the elementary school curriculum. A total of 20 1985 participants and 26 1986 participants completed the Pre-Institute questionnaire. Comparative data are available from a total of 24 of the 26 1986 participants who completed the End of First/Second Year Form and these data are described herein. Additionally, 11 1984 Institute participants and 7 1985 participants completed the First/Second Year Form in the Spring of 1987. Where applicable these data will be integrated into the discussion.

The 1986 Institute group reported an average of 11.5 years teaching experience placing them in between the 1984 group with an average of 13.9 years experience and the 1985 group with an average of 8.4 years experience. As in previous years the vast majority of participants were women (92%), and there was an ethnic mix among the group (15% Asian, 12% Black, 8% Hispanic, 65% White). Participants taught at grade levels ranging from kindergarten through middle school, but the majority taught in grades 2 through 5. None of the participants were math majors or minors in college, and only 50% of the group completed math classes at the level of geometry.

Regarding specific mathematics teaching strategies, participants reported considerable change on their year end surveys. Of the fifteen practices listed, statistical significance (paired comparison t-test) was reached on 11 of the items ranging from "feeling enthusiastic about the subject" to "stress problem solving process rather than solutions," and "use 'real world' examples of problems whenever possible."

When asked to describe how the California Mathematics Project had increased or expanded their skills or knowledge in 18 specific areas (using a 5-point

Likert-type scale with "1" meaning "not at all" and "5" meaning "a great deal" the mean responses to all but 4 of the items were 4.0 or above. The highest mean (4.7) was derived in response to "awareness of resources for teaching mathematics," and "belief in the need for changes in math curricula" followed closely by "empathy for students learning mathematics" (4.6), "repetoire of problem solving strategies" (4.6), and "enjoyment of mathematics teaching" (4.6). Similar data were provided by the 1984 and 1985 participants. Among the 1984 group, all eleven respondents marked "5" in response to the statement, "enjoyment of mathematics teaching." The lowest mean scores were found among the 1985 group, but none lower than a rating of "3" or "somewhat," with most deriving means of 4.0 or above.

A dramatic increase in teacher participation in professional associations was noted in the 1985-1986 final report, and this finding was also noted for 1986-87 participants. Whereas only 4% of the group were members of the National Council for Teachers of Mathematics, California Mathematics Council, or local/regional math associations at the time they entered the project, by the spring of 1986 36% were members of the National Council of Teachers of Mathematics, 58% joined the California Mathematics Council, and 50% joined local/regional mathematics associations. Similar data were reported by the 1984 group (43%, 88%, and 78% respectively), and by the 1985 group (17%, 57%, and 33% respectively). It should be noted in comparing the data from the various project groups that the majority of data are available from the 1986 group, the least amount from the 1985 group. Participants from each project year saw themselves emerging as math leaders in their schools. The impact of their inservice programs will be discussed later in this report.

2. Math Skills Test (Parts I and II). As in previous project years, sample questions from the California Assessment Program (CAP) of the California State

Department of Education, Survey of Academic Skills: Grade 8, were used to develop two math tests that were administered on a pre-post-test basis prior to and following the Summer Institute. Part I of the test requires participants to work on problems individually, Part II provides non-routine-type problems that participants work on in groups. Two observations are noteworthy regarding the distribution of participant scores. First, looking at individuals, a remarkable range in scores is apparent. That is, scores range from 100% correct (1 participant) to 33% correct (1 participant). Most of the scores fall in the 70-96% correct range, and only two fall below 50% (33% and 39%). Second, taking the group as a whole, one sees that the questions that are most troublesome are in the areas of geometry and statistics. That is, 62% of the group missed, on the pre-test, question 14 dealing with triangles and question 22 dealing with statistics. On the post-test, however, only 42% missed the comparable geometry question, and 38% the statistics question. Looking again at individual scores, five participants scored 100% on the post-test (an increase of 4 persons). Most remained in the 70-96% range, but two who scored 33% and 39% on the pre-test did not show improvement on the post-test.

3. Daily Evaluations of Summer Institute. Participants were asked to provide feedback on the helpfulness of the Institute workshops at the end of each day. These results are detailed in the October, 1986 interim report. With the exception of two topics (classroom organization and textbook evaluation) all the daily presentations were rated as highly effective. And, in fact, these two presentations received an overall rating of "good," but participants felt the structure for presenting these very important topics might have been improved.

4. Final Evaluation of Summer Institute. Feedback regarding the participants' overall evaluation of the Summer Institute is also detailed in the interim report. Consistent with the daily feedback, the rating of the Institute overall

was also quite high. "Daily Activities Using Manipulatives" received universal support as the msot helpful aspect of the program, and participants reported that the Institute served to increase their skills in both math content as well as teaching strategies. Participants' comments highlighted that the "best" aspect of the Institute was the opportunity for sharing ideas with colleagues. This is a theme that was carried over into the comments regarding the monthly project meetings suggesting that building in time for discussion among peers is a crucial aspect of the program.

5. Evaluation of Monthly Follow-up Meetings. A total of eight (8) meetings with project staff were arranged for participating teachers as a follow-up to the 1986 Summer Institute. Participants from past Institutes were also invited. The meetings were scheduled on a monthly basis with the exception of December when most participants attended the mathematics conference at Asilomar. The November meeting was a joint meeting with the San Francisco Math Teachers Association to hear a presentation by Dale Seymour on "Visual Thinking." There are no evaluative data from this meeting, nor from the May meeting which was a pot-luck and social wrap-up for the year. The attendance figures and feedback from participants for the regular meetings are summarized below.

September Meeting. This meeting drew the largest attendance of the year with 25 (96%) of the 1986 participants and 14 participants from the 1984 and 1985 Institutes. A central theme in the feedback from participants was that this workshop served as a stimulus for launching the year's activities. One teacher commented, "Making contacts with the other teachers was reviving, energizing, wonderful. I had forgotten where to find specific activities and was helped out by others who could remind me . . . ." Another stated, "It is great to be renewed! The new group and the old groups blend nicely together . . . ." There was also a fairly consistent view that the meeting goals could have been accomplished in two rather than three hours, particularly since it was an after school meeting.

October Meeting. This meeting was attended by 17 (65%) 1986 participants and 8 past participants. The meeting focused on integrating math activities into their classroom programs and was very well received. A key theme was the value of sharing. For example, "The sharing of ideas is the best part - I like the incentive to have a specific strand to work with and to come back and

discuss . . . ;" and "The discussions of what to do in class are very useful because they're so specific and classroom tested . . . ."

January Meeting. Attendance consisted of 22 (85%) 1986 participants and six (6) past participants and the agenda included time to share ideas from the Asilomar conference as well as exposure to two activity areas, one of which was calculator activities. One teacher remarked, "I like the teaching and sharing of activities which give us something new to try or something new to present in workshops to teachers above or below my grade level . . . ;" and one teacher very candidly wrote, "I didn't fall asleep, so that must say something."

February Meeting. This meeting had the smallest attendance of the year, thirteen (50%) 1986 participants and 4 participants from previous years, yet was assessed quite positively by those present. Again the predominant theme was the value of sharing, for example, "I still enjoy the sharing a lot. It's great to go home with tried and true ideas;" and several respondents commented on the value of discussions in break out groups of similar grade levels. This feedback is consistent with that from participants in previous years.

March Meeting. A total of 17 (65%) 1986 participants and 6 past participants attended this meeting and the main topics were activities with unusual manipulatives and "building with 3-D structures." The respondents were very enthusiastic about this meeting. In fact, one participant attending for the first time this year remarked, "I haven't been able to come all year - it's great to see the excitment and enthusiasm! I liked doing the activities - it really added a lot to the meeting." Others commented on the meeting being "well organized" and another remarked, " . . . . Loved the location! I enjoy meeting in various parts of the city." Rotation of the meetings had been recommended by 1985 participants and was incorporated into this year's program. Other comments included, "Beautiful surroundings with lovely people . . . ." and "Beautiful and relaxed setting . . . ."

April Meeting. The April meeting was the second to draw the largest attendance from 1986 participants (25 or 96%) and was attended by 5 past participants. The focus of the meeting was a geometry presentation by a high school teacher who is the current president of the San Francisco Math Teachers' Association. At least half of those in attendance used the word "great" in their comments, while others used terms such as "excellent," "wonderful," and "terrific." Sample comments include: "I have a surge of enthusiasm for geometry - Great meeting:" "I learned more geometry than I ever learned in high school. Mike was great! Good session;" and "I wish I had had Mike Serra for my high school geometry class. Perhaps I would have been less anxious, and understood more!" There were also a few more modestly enthusiastic comments that tended to focus on the geometry ideas as somewhat of a stretch for them. For example, "This meeting provided problem-solving for the more able in math. It was interesting to listen to the strategies employed despite my lack of involvement."

In summary, then, the monthly meetings were, as in previous years, well attended and well received. The strongest component, in the eyes of the participating teachers, continues to be the opportunity for sharing common experiences, particularly with others teaching at a similar grade level. Similarly,

rotation of sites was again met enthusiastically, as well as the use of outside speakers.

6. Evaluations of Workshops Provided by Participants. As in previous years of the project, participants were asked to present workshops to colleagues in their own schools, and TECC funds were made available so that 1986 as well as 1984 and 1985 participants could provide workshops in non-project schools. During the 1986-87 school year, a total of 39 math workshops were presented by San Francisco Math Leadership Project participants. Overviews of the workshops are provided on Form A. Written feedback regarding the presentations was solicited from those in attendance. Results of this very extensive feedback are summarized below.

Among the 1986 participants' workshops, data are available from a total of 19 workshops provided by a total of 21 participants either individually or with a partner (or in one case three presenters). Colleagues in attendance (typically about 15 in each session) were asked to rate the "quality of the presentation" and "value of the workshop" on a 7-point Likert-type scale with "1" indicating "low" and "7" indicating "high." Most noteworthy among the results from 219 respondents are the consistently high ratings of presentations and presenters (typically 6.5 on a 7.0 scale, with one presenter receiving a "perfect 7"). Comments reflected colleagues' appreciation of the new and practical ideas for their classroom, the introduction to work in groups, and the hands-on activities. In the words of one attendee, "It was real - not ideal." One of the 19 workshops was actually a workshop series of four "Family Math" presentations for parents. The majority of parents who provided feedback rated the workshops as "enjoyable" and "very useful" and all twelve respondents said they would recommend "Family Math" to a friend. In the words of one parent, "I saw my daughter enjoy math and that is a change for her . . . ." and

another commented, "This has been terrific for the kids as well as myself - very insightful in the manner they attack math problems."

Feedback is available regarding seven workshops provided by eight past participants to faculties in their own schools, or parents (three Family Math series of 2-3 sessions each). The data available from 24 teachers and 37 parents are uniformly positive and are supported by comments such as, "clear, precise;" "very interesting and motivating;" "thought provoking;" and "highly stimulating for all ages." Comments from parents included, "I enjoyed all that was done and I trust you will set up some more enjoyable and informative projects;" and "Nice way to get parents into the school and looking at our math program."

Workshops given by 1986 and past (1984 and 1985) participants in non-project schools totalled thirteen across thirteen different schools, and involved sixteen project participants. Feedback on these presentations were provided by 154 teachers. These sessions were also rated positively (typically 6.5 to 7.0 on the 7-point scale), and generated comments similar to those noted above. Specifically, the use of "hands-on activities" was a consistent winner with those in attendance, and the meetings were seen as both "practical" and "inspirational."

7. Self-Evaluation of Own Classroom and Impact of Project on Own Teaching Practices. In the spring of 1987 a self-assessment, developed and used in the spring of 1986, was distributed to 1984, 1985, and 1986 participants. (Data collected in the spring of 1986 was from 1984 and 1985 participants). Four main areas were surveyed: Classroom Atmosphere, Classroom Versatility, Problem Solving and Thinking Skills, and Learning Component. Details regarding the rating scale are found in the 1985-86 final report. In brief, "1-2" indicates "excellent," "4-5" indicates "needs more focus." New data (Spring, 1987) from the 1984, 1985, and 1986 groups are provided in Table 1.

TABLE 1: Summary of Responses to Self Evaluation of Own Classroom

	1984 Group (n=8)		1985 Group (n=10)		1986 Group (n=25)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
I. CLASSROOM ATMOSPHERE						
a. Atmosphere is positive and conducive to learning	1.8	0.7	1.7	0.8	1.8	0.8
b. Teacher has high expectations	1.4	0.5	1.8	0.7	1.8	0.7
c. Teacher is enthusiastic	1.1	0.3	1.7	0.8	1.7	0.8
d. Structure is confidence building	1.3	0.5	2.0	0.9	2.1	0.9
e. Thinking is encouraged	1.3	0.5	1.9	0.7	1.6	0.7
f. Students are grouped in a variety of ways	1.4	0.5	2.3	1.2	2.3	1.2
g. Children's work in evidence	1.6	0.7	2.9	1.1	2.2	1.1
II. CLASSROOM VERSATILITY						
a. Varied strategies used to teach computing skills	1.4	0.5	2.1	0.8	2.2	0.8
b. Equal time given to mathematics/ arithmetic	1.4	0.5	2.6	0.8	2.0	0.8
c. Teacher provides for differences in students' learning styles	1.8	0.7	2.4	1.0	2.1	1.0
d. Variety of math activities available for students' use	1.4	0.5	2.3	1.0	2.1	1.0
e. Overall content is balanced (many strands, not just arithmetic)	1.1	0.4	2.4	0.7	2.0	0.7
III. PROBLEM SOLVING AND THINKING SKILLS						
a. Emphasis on application in computing	1.8	0.7	2.5	0.8	2.5	0.8
b. Process as well as product articulated	1.4	0.5	2.1	1.0	2.1	1.0
c. Problems are formulated and analyzed	1.6	0.5	2.3	0.9	2.3	0.9
d. Students encouraged to estimate and hypothesize	1.3	0.8	2.0	0.8	2.0	0.8
e. Teacher has problem solving plan	1.8	0.7	2.4	0.9	2.4	0.9
f. Problems are used that have many right answers	2.0	0.9	2.8	1.1	2.8	1.1
IV. LEARNING COMPONENT						
a. Manipulative materials are used to reinforce concepts	1.5	0.8	1.9	1.0	1.9	1.0
b. Concepts are developed from concrete to pictoral to symbolic	1.8	0.7	2.1	1.0	2.4	1.0
c. Activities are used which guarantee success	1.5	0.5	2.1	0.9	2.1	0.9
d. Many approaches and divergent thinking are encouraged	1.5	0.5	2.0	0.9	2.0	0.9
e. Children are enjoying math sessions	1.5	0.8	1.8	0.7	1.8	0.7
f. Children are being challenged	1.3	0.5	1.9	0.8	1.9	0.8

The data summarized in Table 1 are similar to those obtained during the spring of 1986, that is, the highest ratings were obtained, in general, from those participants who had been in the project the longest (in this case, for three years, since 1984). Nevertheless all participants across year levels tended to rate themselves in the "good" to "excellent" ranges in the target areas, thus indicating confidence in incorporating the project strategies into their ongoing curriculum. This increased confidence is also illustrated in participants' year end letters to the project director expressing in their own words the impact of the project on their teaching practices. For example,

- ". . . the project has increased my knowledge in using groups of four, logic and problem solving on a concrete level, and computer programs as extensions to classroom work. My math program has improved markedly in covering all the important mathematic strands . . . . I have placed less emphasis on computation for computation sake alone in favor of more problem solving, estimation, and logic work in realistic situations. . . . The project gave me the incentive to apply for a CTIIP grant to develop an integrated math/science program (which was funded) . . . ." (1986 participant)

- " . . . a variety of problem solving techniques has helped me and my students to be much more positive and willing to try problems that might have, in other days, caused moans and groans. The support of working in groups has also added to their confidence in problem solving . . . . the thing that the project has done best is to put a group of people in touch with ideas, materials, and each other (that) has fostered sharing beyond the boundaries of the Project . . . ." (1986 participant)

- " . . . one important lesson I have learned is to have empathy for students who do not understand. I did not realize the frustration and sense of failure a person can feel when he doesn't know what to do. When I had to deal with the "problem of the day" I was very discouraged . . . however, after working with a group, learning different strategies, and using manipulatives I began seeing the "problem" as a challenge . . . because of my own experience, I have a better understanding of how students feel when a task seems too difficult . . . I, then, tried to show them different strategies to use. As they felt more secure and began having success, their enjoyment of math grew." (1986 participant)

- " . . . . Since my participation in the 1984 summer program, I've grown tremendously in both professional and personal terms. I have gone from a full-time classroom teacher who taught arithmetic page-by-page from a textbook, to a resource teacher . . . experimenting with the teaching of mathematics . . . a district Mentor Teacher in

mathematics, a Math Staff Developer . . , and a member of the California Math Initiative. . . . I believe your project was the impetus for these accomplishments. . . ." (1984 participant)

- "This will be my third year in the Math Leadership Program. As I reflect on my participation in the program, it amazes me to recall how I used to prepare a math lesson three years ago. I would open the teacher's manual, read over the lesson and choose one of the suggested ways of introducing the lesson. Then I would make sure that I had the appropriate dittos run off and decide on the homework. The lesson would include possibly ten minutes of teacher and twenty minutes of student practice. Then correct their seatwork and assign the homework. Now I go about the planning in a different way. I try to think "concrete-pictorial-symbolic." I look for ways to get things into my students' hands. I try to relate the lesson to real world examples and problems. I look for ways to use the blackboard and overhead effectively. I try to find ways to practice the skill that minimizes paperwork . . . . I find that Math is now one of my favorite times of the day. The students seem to enjoy it too. On a graph that we did in class we discovered that it was everyone's first or second favorite subject. Parents often remark about the enthusiasm they witness over math projects and homework. And it's great to see so many of them actively involved in some of the math challenges that the students take home. Because of my involvement with the Project I am often asked to give workshops, lead discussions, give advice about the teaching of math. This is a real ego boost and also an incentive to keep up on my own skills . . ." (1984 participant)

8. Math Related Activities Pursued During the 1986-87 School Year.

All participants were required to attend at least one math conference as part of their participation in the project. Most chose to attend the California Math Council-Northern Section (CMC-N) conference held at Asilomar in December of 1986. Additionally, participants reported their attendance at other math conferences, math related courses taken during the year, and other related activities. These activities will be briefly summarized for the 1986 participants. Conferences other than the CMC-N which were attended by one or more participants included: Richmond Cluster-super Saturday, Albany, December, 1986; California Association for the Gifted (CAG), Los Angeles, February, 1987; Greater San Diego Math Conference, February, 1987; California Math Council-Northern Section (CMC-N) Science Conference, Hillsborough, March, 1987;

California Association of Independent Schools, Oakland, March, 1987; and National Council of Teachers of Mathematics, Anaheim, April, 1987.

Math related courses taken this year by participants included EQUALS (3), Family Math (12), Math Solutions (5), Hands on Science (SFSU) (1), Computer Literacy for the Classroom Teacher (1), and TICC Rewrite/LHS (UC) (1). Additionally, one 1986 Math Leadership participant was also a participant in the Math in Action project sponsored by the San Francisco School Volunteers.

Other math related activities reported by participants were attendance at clinical supervision workshops offered at SFSU (1), serving as Master Teachers for student teachers (8), serving as Master Teachers for student observers (12), and participation in a first year teachers' project at SFSU (1). These reported activities represent a substantial increase in involvement in math related activities as compared to participants' reported activities prior to entering the project.

9. Evaluation of Spring, 1987 Computer Course. Two brief instruments soliciting both numerical ratings and open ended comments were used to obtain feedback about the effectiveness of the computer course offered in the spring of 1987. The course and its instructor received highly favorable ratings (range of means: 1.2 to 1.6 on a 5-point scale with "1" indicating "strongly agree"). Participants reported that the instructor encouraged participation and increased their understanding of the subject matter. All participants said they would recommend the instructor to others. Regarding specific skill learning the feedback was somewhat more modest, but also generally favorable. For example, in response to the statement "I have learned a great deal about computers and how they operate" the responses ranged from "4" (somewhat disagree) to "1" (agree), with a mean of 2.6 (SD: 1.4). Other feedback would suggest that additional time might be needed to more fully accomplish the learning objectives.

That is, in response to the statement "The time alloted for this class was sufficient for what I needed to learn," the mean was 3.4 suggesting a fair amount of disagreement with the statement. This is the only statement that elicited a mean response of 3.0 or above.

10. Evaluation of the Summer Reunion, 1987. All past and current project participants were invited to a two-day reunion meeting during the summer of 1987 (August). Sixteen participants attended (9 from 1986, 4 from 1985, and 3 from 1984). Those in attendance were asked to provide written feedback about their experience and these data are summarized below.

The participants were universal in their assertion that a reunion is a valuable activity each year, particularly because of its value in strengthening the informal or networking ties among the participants from various project years, schools, and grade levels. In fact, there was virtually no negative feedback regarding the reunion, either content or location. Respondents found the most value in the experience from the opportunity to have extended time for sharing ideas and getting to know each other better as a way of facilitating more collaboration in the upcoming school year.

Summary

Data from a variety of sources indicate that the 1987 project year was a highly successful one. The Summer Institute and the monthly follow-up sessions were well received and participants felt they were provided with practical yet exciting ideas for their classrooms. Additionally, participants were able to report very specific changes that occurred in their own teaching practices as a result of their participation in the project, including increased self-confidence in their own math skills. The computer course may require some additional instructional time, but other components of the program seem to be

of about the right length. The practical (hands-on) structure of the program that provides a model for the concepts and strategies being taught is exceptionally well received by participants. As in previous years, the major strength of the project that permeates all the sources of feedback is the opportunity for classroom teachers to develop a network of supportive colleagues who are struggling with similar issues. The teacher participants seem to serve as quite signfificant resources for each other, and this more informal process seems to be facilitated through the structure of project activities (e.g. monthly meetings attended by participants from all project years, time during the Summer Institute for participants to present workshops to each other, and the year-end reunion).